Aviation Rulemaking Advisory Committee
Fuel Tank Inerting Harmonization Working Group

August 7, 2001

Mr. G. Michael Collins,
FAA Representative,
Fuel Tank Inerting Harmonization Working Group
Transport Airplane Directorate
Aircraft Certification Services
1601 Lind Avenue, S.W.
Renton, Washington 98055

Reference: Letter dated June 29, 2001, to Mr. Bradford A. Moravec and Mr. Sean B. O'Callaghan.

Dear Mr. Collins,

As co-chairman of the ARAC Fuel Tank Inerting Harmonization Working Group we have agreed not to revise the final ARAC working group report as requested in your referenced letter. The Working Group had previously discussed the questions raised by this letter and we believed we had general consensus on these issues. These issues are also addressed at length in the final report.

The goal of the Working Group was to gain consensus on study assumptions and conclusions. According to the ARAC operating procedures, "General consensus means that, although there may be disagreement among the members of the group, the group has heard, recognized, acknowledged, and reconciled the concerns or objections to the general acceptability of the group. Although not every member fully agrees in the context and principle, all members support the overall position of the group and agree not to object to the proposed recommendation." At last working group meetings in June, we believed we had general consensus from all of the Working Group members.

The members of the Working Group represented a range of interests from the US and Europe, including airplane manufacturers, airlines, airports, industrial gas companies, pilots, machinists, regulators, and public interest. These groups participated in the study because they support government and industry efforts to improve fuel tank safety. The working group recognized that overstating costs or technical issues could result in a missed opportunity to improve fuel tank safety. On the other hand, understating the costs or other issues could result in recommending a method of improving fuel tank safety that is technically infeasible, takes too long to implement, or is so costly that it is scrapped before any benefits are realized. In this case, the opportunity to introduce practical fuel tank safety improvements could be delayed.

For these reasons, every attempt was made to accurately represent the technical requirements, safety benefits, regulatory matters and estimated costs. Your letter points out assumptions that you believe overstate the cost and risk and understate the benefits. We do not believe this is the case as we have outlined below and documented in the final report. The discussion below repeats sections from your letter followed by our comments, shown in Italics.

Discussion:

FAA Statement:
Summary: The FAA, as a member of the FTIHWG, disagrees with certain assumptions and has questions on other assumptions used in this study. The assumptions used in the study are critical to the cost estimates provided for the fuel tank inerting options studied. Therefore, the FAA has some reservations as to the accuracy of the Working Group's conclusions expressed in this report. Those conclusions produced inerting system cost estimates in the tens of billions of U.S. dollars with relatively minor benefits from inerting for the fifteen year study period. The FAA's questions can only be answered following a full review of the data in the appendices to this report. As stated in the Task, the FAA will use the data in the report and results of independent FAA research and development programs in evaluating if a practical means of inerting fuel tanks can be found for the in-service fleet, new production airplanes, and new airplane designs. This attachment to the report provides an explanation of the most significant issues.

Significant FAA Disagreements:

Ground Based Inerting, Dedicated Personnel Not Required: The FAA disagrees that the person who would perform the inerting tasks needs to be a dedicated person or remain present and observe the entire inerting process after connecting the nitrogen enriched air (NEA) hose to the airplane connection, opening valves and starting the inerting of the tank(s). This is in conflict with the conclusion of the FAA/industry team contained in FAA report DOT/FAA/AR-00/19, *The Cost of Implementing Ground-Based Fuel Tank Commercial Fleet*, dated May 2000. In addition, the safeguards included in the design concepts developed by the task team preclude the need for dedicated personnel to observe the process. The use of dedicated personnel has a very significant contribution to the total estimated cost for ground based inerting presented in the report.

Response:

The assumption that a ground service person would attend to the complete fuel tank inerting process was discussed many times in our working group meetings and Telecons. Section 5.4.5 of the final report outlines the tasks performed by the ground service person and reasons a dedicated person is required. To summarize, a dedicated person is required to: a) verify the inerting process was completed correctly and accurately reported to the flight crew; b) ensure that the inerting process is done in a coordinated and timely manner to avoid conflicts with other ground service activity and minimize the potential for flight delays; and c) ensure that the inerting process is done by a properly trained person to prevent injuries and airplane damage. For the inerting operations that

are accomplished by a mobile system, the vehicle driver would also be the one responsible for inerting the fuel tank. In this case, there would be no point in leaving the vehicle. Large and medium sized airports would have some mobile inerting to service remotely parked airplanes. Small airports, which constitute approximately 85% of the airports in the study, would only have mobile inerting.

With regards to the significance of this assumption to the overall estimated cost, by assuming that none of the inerting is performed by a dedicated ground service person, (i.e. accounting only for the labor to connect and disconnect the inerting system) the cost reduction is less than 5% of the total cost over the study period.

FAA Statement:

Ground Based Inerting, Technician (Mechanic) not required: The FAA disagrees that a technician (mechanic) is required, even for some start-up period, to perform the tasks required to inert the fuel tanks.

Response:

In section 4.5.4, the Operations and Maintenance experts on the study recommended that the inerting process be performed by a skilled mechanic until the inerting systems were automated and reliable. The intention is to ensure the process is done correctly and avoid possible injury or damage to the airplane. Nevertheless, the additional cost of using a mechanic for the start-up period was not included in the cost-benefit study.

FAA Statement:

Special Federal Aviation Regulation (SFAR) No. 88, Predicted Accidents Avoided: The report assumes that the SFAR would prevent 75 per cent of future fuel tank accidents. This assumption has a very significant affect on the predicted benefits for fuel tank inerting shown in this report. The 75 per cent prediction is not supported by any data or by the FAA Final Regulatory Evaluation that was included in the final rule that issued the SFAR (docket number FAA–1999–6411, published in the Federal Register on May 7, 2001). When performing that final regulatory evaluation, in response to comments received to the notice and further analysis, the FAA determined that such a prediction has no acceptable mathematical basis. In addition, the ignition source in the three most recent fuel tank explosions (1990 Philippine Airlines, 1996 TWA 800, and 2001 Thai Airways) has not been determined. The SFAR, and any resulting required modifications, could eliminate possible failures and malfunctions that have been identified since the TWA 800 accident that can cause an ignition source, and this will provide a needed improvement in the safety of fuel tanks. However, even if all those potential ignition sources were eliminated as a result of the SFAR, there is no way to positively determine if that action would have prevented those accidents. This is very important in the FAA's overall program to prevent future fuel tank explosions. That is the reason for the FAA's determination that it will take both eliminating potential ignition sources and eliminating

or significantly reducing the exposure of fuel tanks to flammable fuel/air mixtures to provide an acceptable level of safety.

Response:

The 1998 ARAC study estimated that the fuel system improvements and improved maintenance practices expected from the proposed SFAR rules would reduce the fuel tank accident rate by 75%. There were no changes to the final SFAR rule that would reduce the expected SFAR benefits. The consensus of the Working group was that accounting for a 75% ignition source reduction was an appropriate assumption.

While the FAA final version of the SFAR does not state a specific reduction in ignition sources, it does state "the FAA believes that the rule will significantly reduce the risk of a future accident". Considering extent of the fuel system improvements that are likely to be required to comply with SFAR 88, the majority of the working group believed that the benefit from SFAR 88 should be included, and the consensus was to use the 75% previously estimated.

FAA Statement:

Hazard to Passengers and Crew from Inerting Systems: The FAA disagrees that nitrogen enriched air (NEA) or oxygen enriched air produced by the membrane separation technology used in the study creates a hazard for passengers and crew of the affected airplanes (on-board or ground-based designs). The design concepts used in the study included features to preclude leakage of either NEA or the oxygen enriched air byproduct of the inerting systems from entering (pressurized) areas of the cabin that would be occupied by passengers and flight crew members. In addition, existing Federal Aviation Requirements would prevent obtaining FAA approval of any inerting system design that would prevent a hazard to passengers or flight crews.

Response:

As discussed in section 4.4 of the final report, high concentrations of nitrogen can cause death in seconds. All known design, operation and maintenance measures would be taken to prevent hazards to the passenger and flight crew. However, because of the uniqueness of some of these inerting systems to commercial aviation, all hazards can not be completely ruled out. This is why the working group recommended that this issue be studied further. The cost-benefit analysis did not include inerting accidents.

FAA Statement:

Hazard to Maintenance Personnel from Inerting Systems: The FAA disagrees that nitrogen enriched air (NEA) or oxygen enriched air produced by the membrane separation technology used in the study creates a significant hazard for maintenance personnel working on or near the affected airplanes (on-board or ground-based designs). The design concepts used in the study included features to preclude leakage of either

NEA or the oxygen enriched air byproduct of the inerting systems from entering (pressurized) areas of the cabin that would be occupied by maintenance personnel. Regarding hazards to maintenance personnel when entering confined spaces where inerting equipment may be located or fuel tanks after they have been inerted, confined space entry requirements established by industry and required the U.S. Occupational Safety and Health Administration for areas with potential to have oxygen depleted atmosphere would prevent injury to maintenance personnel. The oxygen-enriched air discharged from the membranes, as a byproduct, does not have a high enough oxygen concentration to create a fire hazard.

Response:

Again, as discussed in section 4.4 of the report, high concentrations of nitrogen can cause death in seconds. All known design, operation and maintenance measures would be taken to prevent hazards to the passenger and flight crew. However, because of the uniqueness of some of these inerting systems to commercial aviation, all hazards can not be completely ruled out. This is why the working group recommended that this issue be studied further. The cost-benefit analysis did not include inerting accidents.

FAA Statement:

Significant FAA Questions:

Incorporation of Modifications Resulting from SFAR No. 88: The report assumes all modifications that would be required as a result of the SFAR design review would be incorporated throughout the fleet by 2006. This assumption has a very significant affect on the predicted benefits for fuel tank inerting used in forming the conclusions in this report and it may be overly optimistic. The SFAR requires that affected type certificate holders and supplemental type certificate holders perform a safety review of their fuel tank systems and determine if their designs meet the latest requirements for precluding fuel tank ignition sources. If it does not meet those requirements, they must develop all design changes necessary to meet those requirements. The results of the design review are to be submitted to the FAA in a report by December 6, 2002. (If they can not develop all the design changes by the compliance date, they can be granted an extension of time to develop those design changes if certain conditions are met.) The FAA will then review the reports and the design changes. If the FAA determines that modifications are required to existing airplanes, the FAA would issue proposals for airworthiness directives (ADs) that would require that the airplanes be modified by some future date. The time allowed in the final ADs to modify in-service airplanes would depend on the complexity of the modifications. The FAA questions the ability of the industry to develop all the required modifications and then modify all the in-service airplanes in the three year period following the compliance date for the SFAR, especially considering the industries history of waiting to begin modifying in-service airplanes until after the FAA has issued final rule ADs requiring the modifications.

Response:

The cost-benefit analysis assumed SFAR changes would be fully implemented by 2007 (not 2006). The benefits of SFAR are based on expected design improvements and improved maintenance practices. The final SFAR rule requires operators include these improved maintenance practices by June 2003. Although maintenance practices will have an immediate improvement in fuel tank safety, no benefits were assumed until 2007. The final SFAR rule requires that TC and STC holders develop any design improvements required to meet the new rules by December 6, 2002. It was assumed that the design changes would take approximately 4 years to implement. There may be delays in implementing the design improvements either because TC/STC holders cannot complete their design development by December 6, 2002 or the operators need more than 4 years to install the design changes. As shown in figure 1-3, as long as these design improvements are implemented by 2010, there would be almost no change to the accident rate and consequently, the cost-benefit analysis.

FAA Statement:

Inerting Implementation Schedule: The schedule for implementing fuel tank inerting in the fleet shows no affect on safety until beyond 2010. The full affect is not shown until 2015, when all modifications are completed. This is shown for both ground-based inerting and on-board inerting designs. The data in the report also shows that inerting would be more effective in preventing fuel tank explosions than even the 75 % predicted effectiveness for SFAR 88 used in the report. Therefore, improving the implementation schedule for inerting combined with a more realistic schedule for incorporating modifications resulting from the SFAR would greatly improve the cost-benefit ratio for inerting.

Response:

For the purpose of a cost-benefit analysis, the working group assumed that the earliest the FAA could promulgate an inerting rule would be 2005. This is an optimistic assumption because of the complexities of the rule changes required, especially for a world-wide implementation. The working group assumed that airplane manufactures could create designs for 107 major and derivative airplane models within three years. This is a very optimistic assumption because of the number of airplane models and the uniqueness of these inerting systems to commercial aviation. The working group assumed that operators would need 7 years to fully implement the inerting systems. This is based on installing the system during a scheduled heavy check. To address airplanes with heated center wing tanks, this would require retrofitting approximately 1800 airplanes per year. All three of these assumptions are optimistic. Any increase in the time required to fully implement the inerting system would decrease the benefits.

Summary

Every attempt was made to accurately represent the technical requirements, safety benefits, regulatory matters and estimated costs. Your letter points out assumptions that you believe overstate the cost and risk and understate the benefits. As we have outlined above and documented in the final report, we do not believe this is the case. In fact, we made several optimistic assumptions that reduced the estimated cost of implementing an inerting system and decreased the time it will take to implement it. These assumptions include:

1) *unlimited resources, such as engineers, mechanics, hangers, parts, or facilities*
2) *no increase in the average airplane turn-time at the gate*
3) *allowing MMEL dispatch of an inoperative inerting system*
4) *no growth in the number airports*
5) *modification of only 100 passenger and above airplanes*
6) *no airplane or airport equipment depreciation or replacement*
7) *15% of the future fuel tank accidents occur on the ground (currently the rate is 67%)*

If any of these assumptions proves to be mistaken, the costs may be higher or the implementation time may be longer. The assumptions made for the cost-benefit analysis attempted to balance the risk of over or under estimating the costs.

We expect the FAA to fully review the final report once it is submitted by the ARAC Executive Committee. We hope you find that the final report adequately addresses the questions raised in your letter.

Sincerely,

Bradford A. Moravec
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ARAC Fuel Tank Inerting
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